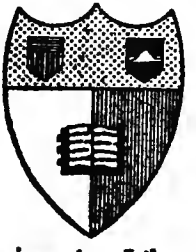

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THE OIL SITUATION IN NEW MEXICO

A PRELIMINARY REPORT

BY

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INTRODUCTION

Reasons for the Investigations

With the rapid increase in petroleum consumption, there has come within the past four or five years a wide and persistent search for new deposits. New Mexico, being a comparatively little known state geologically, and lying adjacent to the great producing state of Texas as well as near the oil-producing areas of Colorado, has become a center of exploration by oil prospectors. Every county has been traversed by the geologists of many companies. One eastern company is reported to have spent $90,000 in gathering data on the geology of the state. Many favorable indications of oil have been discovered and drilling has been done in scores of places. Up to the present time, all the efforts have failed to demonstrate the presence of oil in paying quantities, although some traces of oil have been discovered.

During the past two or three years the office of the state geologist has had hundreds of calls for information on the geology of the state, especially with reference to oil possibilities, It has been impossible to supply these demands, in many instances, because of the absence of published information on the subject. Many Government publications deal with certain areas, and a forthcoming bulletin of the United States Geological Survey is expected to comprise a description of the geology, with a geological map of the state. The following report is the result of a series of reconnoissance trips made by the writer during the early part of the summer of 1920 for the purpose of securing data on the conditions having to do with oil production in the state.

Acknowledgments

In the absence of any legislative appropriation strictly for a geological survey these investigations were made possible through the efforts of President David S. Hill of the State University and the considerate action of the Board of Regents. To these men the writer is indebted for encouragement, in this way, toward what he felt was a most important undertaking for the

state. He will be gratified if the matter herein included is of some benefit to those interested in oil propisitions in the state and of ultimate use in the promotion of the interests of the state's resources.

Data on oil wells are not easy to secure. There is no official means of articulation between the State Geological Survey and companies doing business in the mineral wealth of the state. Any information obtained had to be gone after, and even then it was often impossible to get what was wanted. In many cases, however, oil companies have courteously contributed such data as they could reasonably be expected to give. The writer wishes to acknowledge these courtesies, without which he could have done little toward collecting desirable material for this report.

It is to be regretted that more detailed information could not be obtained in regard to geological conditions of the several areas. Time could not be spared for more than very general attention to structure and stratigraphy. While attempting to state facts regarding local conditions as gained by personal observation, the writer has relied extensively on published descriptions of portions of the state, reference to which is here acknowledged. The data on the main subject of the report are necessarily far from complete. A number of wells could not be visited and some portions of so large a state as New Mexico, it may be supposed, were not traversed. It would have been more satisfactory to the writer if every company doing oil-exploratory work in the state could have contributed data. Since it was impossible to advise with representatives of all of these companies, it is hoped that no feeling will arise that any slight is intended in the omission of reference to certain oil projects. No favoritism is held by the writer. It is not his wish to omit recognition of any facts that would help the general public to a better unuderstanding of actual conditions relating to the oil situation in the state. He is aware that scientific accuracy cannot altogether be claimed for this report, and any one who can suggest corrections should feel free to do so. In the light of further investigations, certain statements may need to be revised. Many logs of wells, now withheld by drillers, may be available later on.

Acknowledgement is made of helpful suggestions from President David S. Hill and Dr. Fayette A. Jones, who have read portions of the manuscript.

Summary of Literature

The earliest published data on New Mexico oil prospects, as far as known to the writer, are embodied in a publication by Dr. Fayette A. Jones,[1] in 1904. Dr. Jones cites many localities where indications of oil appeared in the counties of Guadalupe, Colfax, Union, McKinley, Eddy, Lincoln, Otero, San Juan, Socorro, and possibly Luna. In many of these same localities wells have since been drilled. He suggests the possibility of the petroleum, if present, being too deep-seated to have been reached by the drills at that time; or that, if once having existed, the oil has been dissipated in consequence of the igneous activities of the region.

G. B. Richardson[2] briefly records the development of the petroleum industry near Dayton, N. M. He shows that several wells had been drilled there previous to 1913. Traces of oil and gas were found in several wells. Oil was first discovered in a deep well drilled for water. The best yield was from what is known as the "Old Hammond" well, later called the Brown well. The well was drilled in 1909. It is 950 feet deep. In 1911 it yielded six to ten barrels a day for several months. In 1913 it was producing about twenty-five barrels of oil a day.

The oil is reported as being a fuel oil, containing little or no gasoline. It occurs near the base of the Red Beds of the Pecos Valley. The same relative horizon in the Electra field, Texas, produces a high-grade light oil.

In his bulletin on the Mineral Resources of New Mexico, Dr. Fayette A. Jones[3] suggests the existence of three horizons favorable to produce oil—one in the upper marine Cretaceous shales, one in the lower Cretaceous, and one in the Triassic or Permian. Speaking of the different areas where oil might be found, he says, "It is the opinion of the writer, that one of the principal gas- and oil-bearing zones of Pecos Valley region starts in the vicinity of Artesia and passes in a slightly curved line through Dayton, running a little to the west of Lakewood, thence southeasterly, crossing the Pecos through to Avalon and thence farther southward toward Alkali Flat and Salt Lake. Another similar zone heads in about Stillwell's ranch and Dexter, passing southeasterly through Hagerman toward the Mescalero Ridge." Dr. Jones thinks that the Brown and the Belt wells indicate the possibility of an important petroleum field some day occupying the Pecos Valley.

Other parts of the state that seem to Dr. Jones favorable to

oil occurrence are near Gallup, Wingate, Antonio Sedillo Grant, various parts of Navajo Reservation, western Socorro and Valencia counties, Hagen coal field, the plains of Jornado del Muerto, and parts of Guadalupe and Colfax counties.

Prof. E. H. Wells[4] describes an area of 137 square miles located in northeastern Socorro County and southeastern Valencia County. He shows that the general structure of the region is a series of sediments tilted toward the west and the southwest, the eastern part dipping to the west 2 degrees to 8 degrees, the southern part dipping to the south and southwest 2½ degrees to 7 degrees. The western part dips to the southwest 2 degrees to 6 degrees. The district is traversed by several anticlines, whose general direction is north and south.

The rocks of the district comprise sediments of Pennsylvanian, Permian, Triassic and Cretaceous ages. Of these formations, only the Cretaceous and Triassic appear at the surface in the district.

As to the possibility of oil occurrence in the district, Prof. Wells suggests that if the concealed Carboniferous beds correspond in attitude to the exposed Puertecito formation, the conditions are favorable for oil. His final conclusion is that there is "not more than a fair possibility of finding productive reservoirs of oil and gas in the Puertecito district."

Mr. Jo. E. Sheridan[5] in his report on his inspection of coal mines of the state devotes some space to a consideration of the oil situation in New Mexico. He cites numerous instances of activity in oil prospecting in many parts of the state. He expresses belief that every county in the state possesses oil possibilities from a geological standpoint. He calls attention to the fact that many large oil companies are investing money in the investigation of the oil possibilities and that wells are being drilled in many counties.

Commenting on the general structural conditions in New Mexico, Mr. N. H. Darton[6] states that "only a few deep wells have been bored in New Mexico and these are in places where the structure is not favorable for the occurrence of oil or gas, or the wells were not drilled deep enough to make them satisfactory tests." Mr. Darton warns against too great excitement over "the hectic literature written to promote the sale of oil stock."

In behalf of conditions that might prove favorable for oil, he mentions the following localities: Guadalupe county, T. 11 N., R. 19 E.; on Pintado Creek in T. 8 N., R. 10 E.; in the N. E.

corner of this county and in southern San Miguel County; Quay County a short distance east of Tucumcari; in De Baca County; in Lincoln County, near Lincoln, and in T. 6 S., R. 9 E., T. 9 S., R. 8 E., and T. 5 S., R. 12 E.; in eastern Socorro County, 3 miles northeast of Carthage coal mines; at Prairie Springs, in T. 2 S., R. 4 E., and at the north end of the Oscura Mountains.

Mr. Dean E. Winchester[7] in the Geology of Alamosa Creek Valley, Socorro County, New Mexico, gives special reference to the occurrence of oil and gas therein. He shows that the area he discusses lies north of the Bear, the Gallina, and the Datil Mountains, between the Sierra Ladrones and the Continental Divide and north to the north line of T. 4 N. He shows that the rocks of the area range from Carboniferous to Recent. The Cretaceous he divides into Dakota sandstone, the Miguel formation, largely sandstone, and the Chamiso formation, containing soft sandstone and sandy shales, with coal beds. These last two formations correspond in position to theMancos shale and Mesaverde.

The structure of the area is, in general, westward-dipping, the older strata outcropping successively to the east. There are many foults and small folds, and these usually accompany one another. The Red Lake anticline extends from sec. 21, T. 3 N., R. 8 W., northward about 13 miles. The La Cruz anticline enters the area at the north and passes southeast toward the northwest corner of T. 1 N., R. 5 W.

He suggests that the Red River anticline would provide a good place for the accumulation of oil if it occurs in rocks below the Dakota sandstone.

Referring to David White's theory concerning the relation of oil to occurrence of coal, he states that the coals of the Chamiso and Miguel formations have a low enough per cent of fixed carbon to allow the possibility of oil occurrence in those formations. He suggests a suitable place for a shallow test well in these formations as being near the center of sec. 19, T. 4 N., R. 9 W. A deep well to test the older formation would be favorably located near Red Lake, in sec. 2, T. 3 N., R. 8 W.

Mr. John K. Knox,[8] discussing the probability of oil occurrence in New Mexico, concludes that the eastern and southern portions of the state give rather poor encouragement for the discovery of oil therein. The Canadian River valley lacks suitable storage horizon, and structures, if present, are difficult to

locate. The Santa Rosa-Tucumcari region has many apparent structures, whose origin is uncertain and which have no probable associated petroliferous beds. The Pecos Valley gives no evidence of large possibilities. South-central New Mexico may possess oil possibilities in the deeply buried Paleozoic limestones. "The Plateau Province offers the best chance for future production."

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1 Jones, Fayette A., New Mexico Mines and Minerals, page 278, 1904.

2 Richardson, G. B., Petroleum near Dayton, New Mexico: Bulletin 541-D, U. S. Geological Survey, 1913.

3 Jones, Fayette A., Mineral Resources of New Mexico: Bulletin 1, New Mexico School of Mines, 1915.

4 Wells, E. H., Oil and Gas Possibilities of the Puertecito District, Socorro and Valencia Counties, New Mexico: Bulletin 3, New Mexico School of Mines, 1919.

5 Sheridan, Jo. E., 8th Annual Report of the State Inspector of Mines, 1919.

6 Darton, N. H., Oil and Gas Prospets in East Central New Mexico: Press Bulletin, March 1920, U. S. Geological Survey, 1920.

7 Winchester, Dean E., Geology of Alamoss Creek Valley, Socorro County, New Mexico: Bulletin 716-A, U. S. Geological Survey, 1920.

8 Knox, John K., Geology of New Mexico as an Index to Probable Oil Resources: Bulletin, Am. Assoc. Petr. Geologists, Vol. 4, No. 1, 1920.

TOPOGRAPHIC AREAS

Park Mountains

New Mexico includes a great variety of topographic and structural features. The north-central area, including Taos County and portions of adjoining counties as far south as Santa Fe, has been called the region of "park mountains." It is the southern extension of a system of folded ranges having a general north and south trend. The mountains are rough, and forest-covered on their flanks, while between the ranges are beautiful park-like valleys. The central parts of the uplifts are mainly granitic or metamorphic rocks from which the sedimentary beds have been worn away.

Great Plains Border

That part of the state lying, for the most part, east of the 105th meridian is within the Great Plains region. It is essentially a plateau that has been extensively dissected and eroded by streams. Portions of the original plateau surface still remain, forming broad, flat areas remote from the main drainage lines. The most extensive of these high surfaces occur next to the Texas border, being a part of the Llano Estacado.

The general structure of the area is a gentle eastward dip of the strata. Following the effects of differential erosion in the tilted strata, the main axis of drainage is north and south. In the northern part of the state the Canadian River follows this axis as far as eastern San Miguel County. Farther south, from Guadalupe County, the Pecos River continues along this axis to the Texas boundary. Between the two valleys rises a barrier formed by a series of low uplifts, which enters the state in the latitude of Quay County. This has diverted the course of the Canadian River eastward.

The surface formations of the eastern section of the state range from the Pennsylvanian to the Tertiary. The oldest of these outcrops lie towards the west. From Pecos River to the Sacramento Mountains, limestone formations of the middle Permian are the surface rocks. East of Pecos River rises an escarpment 150 to 300 feet high, at the top of which an undulating surface extends eastward 20 to 30 miles. This escarpment shows many alternating beds of gypsum and red sands and

clays. The eastern edge of these beds passes underneath another escarpment formed by the protecting limestone beds of the Tertiary. South of the middle of Eddy County, Permian limestone outcrops are common, and the prevailing dip is southward.

From Las Vegas northeastward Cretaceous beds outcrop over a considerable area along the Canadian River, being overlain by later formations throughout the greater part of Union County. The Cretaceous and Triassic in the north, and the Permain in the central and southern parts of eastern New Mexico are overlain by extensive areas of Tertiary sediments reaching westward from the Texas line. The Tertiary beds are usually characterized by a limey formation at the top called "caliche," which is the surface rock over the level stretches of the Staked Plains and their outlying portions in eastern New Mexico. This deposit appears intermittently as far west as the central part of Torrance County.

Bolson Plains and Block Mountains

The middle and southwestern section of the state comprises an area of relatively level country from which rise numerous and somewhat isolated mountain peaks and ranges with a general trend north and south. The typical structure here is that called "bolson-fault-block." Through a series of faults, sections of the surface have been raised and tilted, leaving a steep and ragged escarpment on one side and a relatively gentle slope on the other. Since the uplift, wind, rain, and torrential streams have reduced the rugged heights and filled the lowlands with the debris so deeply that they are like islands in a sea of gravel and sand. These intervening valleys—called "bolsons"—have little, if any, established surface drainage. The swollen mountain steams soon lose their energy in the thirsty level sands below. There are few outcrops of strata except on the mountain slopes, which furnish the main clue concerning the stratigraphy of the region. Sediments thus exposed are confined mostly to those of Paleozoic age. Pennsylvanian and older rocks outcrop around many of the uplifts, while Tertiary sediments overlie and conceal much of the older deposits.

Plateau Region

That portion of the state lying generally west of the 107th meridian and north of the 34th parallel, forms a part of the

"Colorado Plateau." It is an area of relatively few mountain ranges. The prevailing type of topography is a much-eroded plain, whose variations in elevation are due to the unequal erosion of level or slightly-dipping sediments. Numerous outflows of lava spread over wide areas, forming a protective covering to surfaces of pre-Tertiary age. Later erosion has lowered the unprotected parts hundreds of feet. The central portion of this area is dominated by the "Zuni uplift," a granitic stock, from which strata dip outward in all directions. The northern half of the area forms the San Juan Basin. This more nearly approaches the plateau type of topography. Its surface presents a marvelous display of erosion, and suggestions of former oscillations of level and variations of direction of drainage.

The prevailing surface formation here is the Cretaceous. This formation is overlain in the northeastern part of the Basin by Tertiary sediments, the successively older formations outcropping around in belts of irregular width.

HISTORY OF THE OIL DEVELOPMENT

Oil prospecting in New Mexico is of comparatively recent date. While traces of oil in certain parts of the state may have awakened some interest in former years, the beginning of the more recent excitement reaches back only about 10 years. For some years previous, artesian wells had been sunk in the Pecos Valley. A brief account of the early development of oil-finding near Dayton is given by G. B. Richardson in Bulletin 541-D., U. S. G. S. From 1909 to 1913 the prospects of oil production in that locality were quite favorable. Several barrels a day were secured from one well. Another one yielded a combustible gas in considerable quantity. Showings of oil have occurred in many artesian wells in the vicinity.

About as long ago as the finding of oil near Dayton, discoveries were made in the Seven Lakes region, McKinley County. This has lately become one of the most encouraging fields.

No great effort seems to have been made to demonstrate the presence of oil in the state until about three years ago. At the present time it is estimated that 50 wells have been started in the state. Some of these have been abandoned, some are being drilled, and in some work is temporarily suspended. New wells are being spudded in quite frequently. Very elaborate and thorough drilling operations are being conducted by several companies.

PRESENT CONDITIONS, BY COUNTIES

Bernalillo County

This county, the smallest in the state, lies toward the northern end of the bolson-block area. The most prominent elevation is the Sandia range, which extends partly across the east end of the county from the north. The range is an eastward-dipping block, whose rim rises 5,000 feet above the Rio Grande Valley. The crest is formed of thick beds of Pennsylvanian limestone overlying a granite core. The westward-facing escarpment is very rugged. To the east of this range the surface slopes gently toward the Estancia Valley. Westward to the Puerco River the surface is a sandy mesa, cut by the valley of the Rio Grande. The older formations are largely hidden by Tertiary deposits.

The general structure of this portion of the county is an eastward-dipping block, whose escarpment exposes Cretaceous beds along the east side of Puerco Valley. A portion of the area west of the Rio Grande is covered with lava flows of local origin.

Several prospect holes have been started. One of these is located about half a mile west of the railroad station of Isleta. Another is now being drilled about 5 miles northeast of Albuquerque.

Chaves County

This county is largely within the Pecos Valley. Its northeastern quarter is a tableland capped by Tertiary limestone. This formation ends abruptly about 6 miles east of the Pecos River, in the latitude of Acme station, but retreats eastward farther south. It is of the same horizon as the surface rock of the Staked Plains. The southeast quarter of the county has a rough topography, formed on the series of Red Beds exposed below the cap rock. The Pecos River has cut into the Permian beds and removed the higher deposits from most of the area. To the west, limestones of the Permian are exposed. The general attitude of the beds is a gentle eastward dip. Over the relatively level surface of the county lying within a few miles of the river, numerous structural undulations occur.

Many wells have been drilled for artesian water from Roswell to Carlsbad. The source of water is a sandstone member of the Permian. This stratum is reached at a depth of about 800

feet along the river valley. The same beds outcrop in the Sacramento and Capitan Mountains to the west.

National Exploration Company's Orchard Park well, No. 2, is located on the S. E. ¼ sec. 15, T. 12 S., R. 25 E., 11 miles S. E. of Roswell. This well was located on a structure indicated by artesian well logs. Surface features of the location are not prominent. The first limestone was at 534 feet. Drilling is progressing.

Lake Arthur well, No. 3, National Exploration Company, is located in S. W. ¼ S. W. ¼ sec. 15, T. 15 S., R. 26 E. It is about 2½ miles N. E. of Lake Arthur. Drilling is going on.

The logs of these two wells show some similarity to a depth of 534 feet in the Lake Arthur well, being a succession of red and blue clays and gypsum. The thickness of the corresponding beds in the two wells varies considerably, being approximately twice as thick in the Lake Arthur well as in the other. The structure apparently displayed by these well sections is a slowly emerging dome in the vicinity of Orchard Park, with converse movement in the region of Lake Arthur, during sedimentation.

Two other wells are located about 6 miles N. W. of Lake Arthur, but are not being operated.

It would seem that the logs of artesian wells in Chaves County might be utilized to a considerable extent in locating structures.

The Kenna well is located on the N. E. ¼ N. W. ¼ sec. 12, T. 6 S., R. 21 E. This well was started by the Great Western Oil and Refining Company. Most of the leases are now in the hands of another company and the well has been abandoned. The location is on a prominent ridge running north and south between Elida and Kenna. There is some question whether this ridge is a structural uplift or is the result of solution and slumping in contiguous areas.

Colfax County

Cretaceous outcrops appear along the valley of the Canadian River through the county. To the east these beds are overlain unconformably by Tertiary deposits. Tertiary formations also cover areas west of Canadian River in the Raton Mesa region. The Cretaceous shales and limestones have a northward dip in the southeastern part of the county. In the northeastern part

of the county the general dip of Cretaceous rocks is southwest.

The only well being projected is located about 20 miles east of Springer. This is known as the Decker well, No. 1. Its location is in the N. W. ¼ S. E. ¼ sec. 26, T. 25 N., R. 25 E. The surface rocks are the Timpas limestone and the Benton shale. The structure is known as the French anticline.

A number of anticlinal structures are reported in the Raton Mesa region. One of these is the Vermejo Park structure.

Curry County

The general surface is high and level, being in the Staked Plains region. The upper formation is a white nodular limestone, or "caliche," of slight thickness but up to 20 feet thick. This is covered usually with a dark sandy loam. In some places it is overlain by a reddish sand, which is locally heaped into dunes.

There are no oil drillings in the county. As far as is known, no drilling is contemplated.

De Baca County

The broad tableland of Curry County stretches westward and gradually downward to the vicinity of the Pecos River, merging into the plain a few miles northwest of La Lande. River deposits of sand and cemented gravel border the Pecos River in terraces about 100 feet above the river at Fort Sumner. The relatively level topography of the north central part of the county gives way to more rugged surface in the western part, where the monotony is broken by isolated buttes of Red Bed formations.

Two wells have been started in De Baca County. At La Lande a portable rig, in good condition but not operating, was located on a slightly elevated portion of the plain. This well was started by Messrs. Oliver and Sullivan but was later taken over by Clay Oliver, of Wichita Falls, Texas.

The Buchanan well, No. 4, of the National Exploration Company is located in the N. W. ¼ S. E. ¼ sec. 35, T. 2 N., R. 20 E. It was just spudding in on August 13, 1920.

A site for a well is reported on sec. 2, T. 6 N., R. 25 E.

Dona Ana County

The ranges of the San Andreas, the Organ, and the Franklin Mountains border the eastern side of the county, rising above the desert plains on either side. These are typical block mountains, with granite cores forming steep and rugged escarpments beneath the uplifted sedimentary beds. The general surface west of the mountains is a sandy plain through which the Rio Grande has cut a valley to a depth of 600 feet, and of varying width from a quarter of a mile to nearly 6 miles. The drainage is typical of the semi-arid region. The porous surface deposits rapidly absorb the torrential streams from the mountains, leaving ever-deepening deposits of bowlders, gravel, and sand. There is a noticeable absence of tributaries to the major drainage channel.

West of the Rio Grande the surface is diversified by numerous uplifts and lava flows.

No wells are reported from this county. An oil rig is located just across the Rio Grande in Texas, about 6 miles northwest of El Paso.

Eddy County

The general topography and structure are similar to those of Chaves County—eastward-dipping strata that have been deeply and broadly eroded parallel to the strike of the beds. Numerous streams are tributary to the Pecos, from the west, while to the east the surface drainage is scarcely expressed in any permanent streams.

The formations exposed east of the Pecos are mainly the Red Bed series, with the usual accompanying barren condition of surface.

West of the Pecos the surface rises gradually along the eastward-dipping beds of Permian limestones. Outcrops of Permian limestone occur from the 4th Standard Parallel, or about 6 miles south of Lakewood, southward. These outcrops show a general dip to the south. The western and southern parts of the county are quite rugged from the unequal erosion of the upturned strata.

This portion of the Pecos Valley presents many instances of favorable structural conditions. A number of wells have been located and others are being projected.

The Harkey well, No. 1, is located on sec. 15, T. 24 S., R.

27 E., about 6 miles west of Malaga. It is being drilled by the Kansas-Carlsbad Oil Co. The location is rather high up on a group of hills about 2 miles south of Black River. The surrounding country is comparatively level, some 200 feet lower.

Blue Bird, No. 1, is being drilled by the New Mexico Petroleum and Refining Co., and the Pool Oil and Gas Co. The location is 1½ miles south of Carlsbad, on N. E. ¼ sec. 18, T. 22 S., R. 27 E.

The Kansas-New Mexico Oil Co. is drilling on sec. 10, T. 20 S., R. 25 E.

The Pecos River Oil and Gas Co. is drilling on sec. 27, T. 19 S., R. 23 E.

Illinois Producers, No. 1, is located on sec. 16, T. 19 S., R. 26 E., about 1½ miles north of Lakewood. No. 2 is in the S. E. corner of sec. 28, T. 18 S., R. 26 E., in the town of Dayton. This well is located nearly on the apex of the dome on which Dayton is built. The surface is about 100 feet higher than the level of the Belt well.

The two wells that have actually produced oil, and have attracted as much attention as any wells in the state, are the Belt and the Brown wells, located within 2½ miles of Dayton.

The Brown well is located on the west side of sec. 15, T. 18 S., R. 26 E. It was originally drilled as a water well but was later sunk deeper and a quantity of oil was discovered. As high as 40 barrels of oil, it is said, were produced daily, in March, 1913. The yeld of oil was hindered by the flow of water encountered. The well was drilled to a depth of 950 feet. The oil horizon was between 911 and 926 feet. This well is now abandoned, but the tanks, the oil-saturated soil, and pools of oil-covered water surrounding the location are very suggestive of an oil locality. A small amount of oil now accompanies the slender stream of water that flows from the well.

The Belt well is located on the N. W. corner of sec. 25, T. 18 S., R. 26 E. The surface is slightly lower than at the Brown well and, in general, shows as little indication of structure. The Belt well was drilled to a depth of about 1,000 feet. Some oil has been collected from the water flowing from this well, but in scarcely great enough quantities to pay for continuing the simple process of collecting it for local uses.

Another well in this vicinity at one time added to the interest in oil prospecting. Gas was struck in this well, located

about 1½ miles southeast of Dayton, sec. 26, T. 18 S., R. 26 E. This well also has been abandoned.

Grant County

Grant County does not need to rely upon petroleum as an important source of wealth The general dislocated structure of the main portion of the county precludes the possibility of great oil deposits therein. Mineral wealth of other kinds engrosses the attention of her citizens. No oil wells have been reported in this county, although the southern part is probably equally well situated with the adjacent counties east and west, as far as oil possibilities are concerned.

Guadalupe County

The southwest part of the county from Vaughn to Santa Rosa is relatively level and uneroded. The surface is capped by a porous limestone, "caliche," some 15 feet thick. This is underlain by red beds and gypsum. The region contains numerous sinkholes, probably caused by the dissolution of masses of gypsum underneath and the collapsing of the surface formation. The surface slopes gently from the southwest corner to the Pecos River.

From Santa Rosa northeastward the surface is more broken and the predominating formations north of Cuervo are Triassic red beds. The remaining broad mesas still retain the caliche layer at top. Such a surface forms the divide which runs northwest through the northeastern part of the county.

Numerous local flexures occur, some of which are indicated on the map. A number of these structures have been located as sites for drilling. At one of these, about 5 miles northeast of Cuervo, part of an outfit for drilling has been deposited. The location is near the sumit of a low dome about 3 miles in diameter.

A structure lying across the north line of the county is described under San Miguel County.

A well-defined structure lies west of Santa Rosa. It extends from about 2 miles west of the town to the ranch of Tranquilino Apodaca and northwest. It is 5 or 6 miles wide. A well location has been fixed in the S. E. ¼ sec. 5, T. 8 N., R. 20 E.

Southeast of Santa Rosa the Pecos River flows along the axis of a series of uplifts for 10 or 12 miles. The most pronounced portion of this structure is about 3 miles below Santa Rosa.

Two small domes run southward from the north line of T. 8 N., R. 23 E. Another location is in sec. 20, T. 8 N., R. 25 E.

John K. Knox[1] refers to a structure, called the "Los Estaritos dome," located in T. 11 N., Ranges 18 and 19 E. The favorable indications of this dome were not sustained by the results of drilling. Red Beds were penetrated 1,900 feet, and granite was struck shortly below this depth, without finding oil.

Hidalgo County

The topography and structure are practically similar to those of Luna County and southern Grant County,—broad, level plains surrounding isolated mountain ranges of the block type.

One well is reported from this county. It is located 10 miles due west of Lordsburg, T. 22 S., R. 20 W. The Buffalo Oil and Gas Co. drilled here to a depth of 700 feet and operations were temporarily suspended. The log as far as drilling went is as follows:

Log of Well in T. 22 S., R. 20 W.

	Feet.
Clay and gravel	1-340
Coal-black muck	340-344
Blue clay, gravel and "cement"	344-700

Lea County

The high prairies of the Staked Plains form the larger part of this county. The eastward slope of the surface follows the general direction of the dip of the underlying formations, whose outcropping edges form the high escarpment bordering the Pecos Valley on the west. The surface is gently undulating, with numerous shallow undrained depressions.

The surface rock is a thin-bedded caliche limestone of Tertiary age, which is in many places covered with a shifting layer of reddish sand.

The peculiar topography of the region has led to some hopes of finding possible oil structure here. The absence of eroded stream valleys or deep railroad cuts renders the determination of the underground structure somewhat difficult. While some of the surface features may be due to diastrophic movements,

[1] Knox, John K., Geology of New Mexico as an Index to Probable Oil Resources: Bulletin, Am. Assoc. Petr. Geologists, Vol. 4, No. 1, 1920.

it is likely that the dissolution of underlying gypsum beds is responsible for most of the local irregularities of surface.

No drilling is being done in Lea County at the present time.

Lincoln County

The general surface of the county is mountainous or rough. The drainage is mainly to the east, following the structure inclination. Outcrops of Carboniferous and Permian strata prevail on the eastern slope, with numerous igneous exposures toward the central and western part. Sierra Capitan rises to an elevation of 10,000 feet and is a landmark for 90 miles to the east.

The west side of the county, 10 to 20 miles in width, embodies a distinct type of topography. An abrupt descent from the uplifted area marks the line of a series of faults striking north and south. This western portion is part of a great valley formed by the displacement. It is relatively level and largely covered with sand and gravels. A recent lava flow extends from the 1st Standard Parallel South southwestward into Otero County, with a width of 3 to 8 miles.

Favorable structures for oil have been discovered both in the eastern part and in the valley region. Near the village of Picacho, the National Exploration Co. has a standard rig. Drilling is progressing. The site of the well is in the valley of Hondo Creek at the junction of a tributary from the south. The structure appears very distinct and favorable.

At Tinnie, some 5 miles farther up the valley, another good structure occurs; also another about 1 mile above Tinnie.

At Oscuro, near the S. W. corner T. 9 S., R. 9 E., a standard rig was erected some time ago, but drilling has been suspended. Mr. Chas. F. Gray reports a good structure 3 miles northwest of Oscuro.

Luna County

This county lies within the general area of the bolson-block mountains. The surface is, for the most part, a broad, desert plain. The monotonous level of the surface is frequently broken by low ranges of monoclinal mountains, having a general northwestward trend. Exposures of granite and lava-flows occur in several localities.

The great surface of the county is practically without running streams. The principal watercourse is the Mimbres

River, which flows part way into the county from the north but soon loses its water in the sands. To Deming, and beyond, this stream frequently flows, at time of flood.

Sedimentary strata from the Cambrian to Recent time appear at the surface in certain localities and probably underlie much of the area. The out-cropping edges of the older formations appear on the mountain slopes, while the later deposits cover the main portion of the plains.

The general structure of the county has not been determined, owing to the abundance of bolson deposits and the isolated arrangement of outcrops. It is possible that the sediments lie in relatively undisturbed attitude, aside from their faulted and flexed condition as forming the several mountain ridges.

The Florida well, being drilled by the Florida Oil Co., is 6½ miles northwest of Deming, S. W. ¼ sec. 14, T. 23 S., R. 10 W. The well was at a depth of 1,565 feet and still drilling. The formations consist of clay and sand, interlayered, to a depth of 430 feet, where 30 feet of limestone occurs. The remaining depth to 1,430 feet is in shale, sandstone, and gravel, interlayered. At 1,430 to 1,515 feet is white limestone, below which is red shale containing oil. The log is very different from that of the Angelus well.

The Angelus well is located about 22 miles southeast of Deming, on S. W. ¼ sec. 8, T. 25 S., R. 6 W. It is being drilled by the Angelus Oil Mining Association. This well presents a remarkable series of water-bearing strata. It suggests wonderful possibilities for that section of the state, aside from oil development. Log follows:

Log of Well, S. W. ¼ Sec. 8, T. 25 S., R. 6 W

	Feet
Gravel	1- 18
Clay	18- 56
Water sand	56- 75
Clay and sand	75-157
Sand and water	157-164
Clay, sand and gravel	164-222
Quick sand and clay	222-303
Red clay	303-336
Gray caving clay	336-357
Red clay	357-382
Red sliding clay	382-434
Real sticky clay	434-523
Quicksand; water rose to within 35 feet of surface	523-525
Gray sandy clay	525-547
Red clay	547-553

Gray sandy clay	553-567
Red sandy clay	567-573
Gray sandy clay	573-580
Quicksand; heavy flow of water	580-583
Gray sandy clay	583-589
Quicksand and water gravel; water rose above derrick floor	589-594
Sticky gray clay	594-616
Sand and water	616-630
Red clay	630-642
Sand and gravel; water stands 10 feet above ground	642-657
Gravel and water	657-670
Brown sand; water rose 15 feet above surface	670-700
Hard streak of coarse sand	700-724
Quicksand	724-728
Clay, sand and gravel	728-803

A well was started by the Valley Oil Co. in the N. W. ¼ sec. 16, T. 29 S., R. 7 W., a few miles southeast of Columbus. It has been abandoned.

McKinley County

This county lies along the southern border of the San Juan Basin. Its southwestern part is included in the Zuni uplift. The surface features have great variety, but, as a whole, the county is rather rough and difficult of traverse. The Zuni uplift is a dome-like elevation extending over an area 60 miles in length, trending southeast from the vicinity of Gallup and central over northwestern Valencia County. The effects of this uplift are observable over the central and northern part of the county in the general northward-dipping strata of the region. The southwest part of the county is a structural basin, the strata rising toward the Zuni uplift and the state line. The southeastern corner is covered with extensive lava-flows, from which erosion has lowered the adjacent country 200 to 300 feet.

The prevailing formation is the Cretaceous. Older formations are exposed from the Santa Fe railroad south, and reaching to T. 13 N., R. 9 W. The outcropping edges of these formatons, dipping northward, have undergone erosion, causing successive hog-back ridges with wide, flat valleys. Tertiary deposits cover small portons of the northeast and northwest corners.

The Seven Lakes district of McKinley County for several years has been regarded as a likely region for oil production. Seven Lakes (named from seven ephemeral lakes) is a locality in T. 18 N., R. 10 W. The first producing well here was brought

in by the Phoenix Syndicate, at a depth of 475 feet. It is located in sec. 18. This well is believed to have produced 8 or 10 barrels of oil for a short time. It is now capped. The same company drilled near this well, in sec. 19, same township, but drilling was stopped at a depth shallower than that of the first well. A third well was started by this company in sec. 13, T. 18 N., R. 11 W. The formations penetrated by these wells were mainly alternating beds of blue shale and sandstone, with several thin layers of coal.

A well was drilled by another party in sec. 31, T. 18 N., R. 9 W., to a depth of 800 feet. The formations were about the same as in the first 3 wells to 65 feet. Below this, sandstone was encountered all the way. No oil was found. A well was started in sec. 29, T. 19 N., R. 10 W.

In the summer of 1920 the Ruby Oil Co. started drilling on sec. 33, T. 19 N., R. 10 W. This location is on the highest hogback ridge in the vicinity.

Mr. J. F. Branson of Albuquerque set up a small rig on the W. ½ sec. 16, T. 17 N., R. 11 W. Work was abandoned at a depth of 390 feet. The formations were sand and shale, with some thin layers of lignite. Mr. Branson later started a well in sec. 18, T. 18 N., R. 10 W., just west of the Phoenix Syndicate well.

In 1919 the Carter Oil Co. drilled a well in sec. 17, T. 11 N., R. 19 W. It is probable that it penetrated Pennsylvanian strata most of the way. The log shows intervening beds of red shales, brown and gray sandstones, and blue limestones. Water was obtained at 1,006 feet. The well was abandoned at a depth of 1,980 feet, where granite was struck.

Log of Well, S. W. Corner Sec. 17, T. 11 N., R. 19 W

	Feet.
Red rock or shale	1- 270
Sandstone, soft brown	270- 350
Sandy red shale; water	350-1006
Brown sand	1006-1015
Shale	1015-1020
Blue lime	1020-1100
Gray sand	1100-1355
Red shale	1355-1360
Pink sand	1360-1365
Red shale	1365-1550
Blue lime	1550-1565
Brown sand	1565-1575
Red shale	1575-1620
Blue lime	1620-1630
Shale and red rock	1630-1980

One of the most definite structures in the state is located about 25 miles north of Grants, T. 15 N., R. 10 W. The region is one of deeply eroded sediments of Cretaceous age. The uppermost formation is the Mesaverde. This in some places may be entirely dissected, exposing the underlying Mancos shale.

The general dip of strata is northeastward. The outcropping edges of the harder strata form high escarpments overlooking the region to the south. The local uplift is central over sec. 14. The low dome is surrounded by the high escarpments of the outward-dipping Mesaverde sandstones. Extensive faulting has occurred on the periphery of the structure.

A portable rig was erected near the east line of sec. 15. Drilling was begun, but was suspended in the spring of 1920, pending legal adjustments.

The following log was furnished by Supt. S. F. Stacker of Pueblo Bonito Indian Agency:

Log of McKinley County Oil Co. Well on Sec. 18, T. 18 N., R. 13 W., by Gus Mulholland, Gallup, N. M.

	Feet.
Alluvial earth	1- 80
White sandstone, pumping water	80- 240
Hard shell	240- 245
Clay shale	245- 475
Gray sandstone, first flow of water	475- 525
Hard shell	525- 535
Hard gray sandstone	535- 585
Shale	585- 635
White sandstone, carries water	635- 655
Black jack and coal	655- 665
White sandstone	665- 700
Blue fire clay	700- 725
White sandstone, water flowed more	725- 785
Hard shell	785- 805
White sandstone, carries water	805- 845
Dark shale	845- 905
Blue shale	905- 970
Shale	970-1000
Gray sandstone	1000-1030
Sandy shale	1030-1050
Gray sandstone	1050-1090
Shale	1090-1120
White sandstone, water increased	1120-1200
Hard shell	1200-1210
Gray sandstone	1210-1320
White sandstone, water increased	1320-1400
Hard brown shale	1400-1520
Shale and clay	1520-1540

"Small show of oil and gas at 1,535, water is not good between 473 and 525, best flow of water between 1,120 and 1,200. Another flow of water between 1,320 and 1,400.

This well is drilled into the Mesa Verde formation and the sandstone member (San Mateo formation) of the Mancos shale group. Below 1,520 the rocks may be lower part of Mancos shale group, or the shale member proper (Mariano formation)."—J. H. Gardner.

Mora County

The geology of this county does not differ widely from that of the counties lying north and south of it. The western part is more than 1,000 feet higher than the eastern. Prominent igneous masses protrude through, or cover, the sediments in the central part. Cretaceous shales form the surface rocks over a large portion of the county. The eastern end is covered with Tertiary deposits.

No oil wells have been drilled in the county. Surface features suggest a possible favorable structure from 5 to 10 miles northeast of Wagon Mound.

Otero County

This county embraces a considerable variety of topography, although it is located essentially in the region of block mountains and bolson plains. Numerous mountain ranges rise in the central and eastern parts. The southern and western parts are desert plains lying between widely separated mountain ranges. Surface drainage is developed in the northwestern part, but the county has generally no permanent streams. The structure of the region is largely obscured by the loose surface deposits of the intermountain plains.

The Tularosa Basin occupies the western part of the county. This structural depression lies 1,000 feet below the scarp of the Sacramento ranges running northward through the central part of the county.

A number of wells have been located in the Tularosa Basin. The Valmont-Tularosa Basin Oil Co. started a well 6½ miles west of Valmont station. A standard rig was set up and drilling was done to a depth of 125 feet, with an 18-inch casing set in the well. Owing to financial difficulties the project has been temporarily abandoned.

The Southwestern Tularosa Basin Oil Co. is drilling on sec. 34, T. 13 S., R. 7 E., about 12 miles northwest of Tularosa. The drilling had reached about 1,600 feet, with "good indications for oil."

The Olean-New Mexico Oil Co. is drilling 1½ miles west of Escondido station, T. 20 S., R. 9 E. The location is on a slight elevation some 6 miles in diameter.

The Cox Oil Co. is drilling about 20 miles southwest of Valmont.

The Tularosa Basin has numerous low, dome-like elevations over the generally plain surface. These elevations are becoming the sites for many of the wells located in the Basin.

Quay County

Quay County is peculiarly situated in respect to structure and topography. A broad structural elevaton enters the state here, and passes westward into Guadalupe County. As stated before, the Canadian River seems to have been diverted from its southward course along the strike of sedimentary beds and has aided in a rapid dissection of this uplift. The surface is a half-developed pene-plain, with broad areas yet untouched in the degrading process. To the south, the ragged escarpment of the Staked Plains parallels the limits of the county.

The general axis of the uplift runs eastward from the vicinity of Tucumcari to the Texas line.

Numerous wells have been drilled. The deepest, and probably the best known, well is located about 14 miles southeast of Tucumcari. It is in the S. E. corner of sec. 27, T. 10 N., R. 31 E. It is known as the "McGee Test." It was drilled by the Tucumcari Oil and Gas Co.

The well is located in the valley of Plaza Largo Creek on a prominent hill south of this creek. The surface rocks are classed by McGee as Triassic, 450 feet below the top. The well was finished at a depth of 4,014 feet.

Log of the McGee Well, Tucumcari, S. E. Corner Sec. 27, T. 10 N., R. 31 E.

	Feet.
Gray sandstone	0- 30
Red shale	30- 470
Gray sandstone (water—salty)	470- 600
Red shale	600- 666
Sandstone (no water)	666- 676
Red shale	676- 760
Sandstone—water	760- 783
Blue shale	783- 796
Water sand	796- 800
Red shale	800- 905
Blue shale	905- 940

Water sand	940- 970
Red shale	970-1110
Rock salt	1110-1135
Red shale	1135-1400
Sand rock (no water)	1400-1430
Rock salt	1430-1455
Red shale	1455-1625
Lime—light gray	1625-2000
Brown shale	2000-2200
Lime—dark gray	2200-2225
Lime—blue—little gas	2225-2231
Lime—dark gray (saturated with oil)	2231-2256
Lime—black and dark gray, with black and gray partings (saturated with oil)	2256-2372
Salt	2372-2377
Lime—black and dark, with shale partings (saturated with oil)	2377-2550
Brown shale (gas blowout at 2585)	2550-3200
Black lime (showing of oil)	3200-3220
Salt	3220-3225
Brown shale	3225-3325
Red lime and sand—hard	3325-3340
Brown shale	3340-3505
Dark gray lime—hard	3505-3520
Red sandy shale	3520-3550
Blue lime	3550-3575
Blue shale	3575-3595
Red sandy shale	3595-3618
Red sandy lime	3618-3660
Red sandy shale	3660-3685
Brown granitic sand	3685-3730
Brown lime with granitic sand	3730-3808
Brown sand (water)	3808-3815
Red lime with granitic sand	3815-3820
Blue shale	3820-3825
Red lime with granitic sand	3825-3854
Black lime	3854-3859
Blue slate	3859-3869
Brown slaty lime	3869-3885
Dark slaty lime	3885-3898
Blue slaty lime	3898-3900
Dark lime	3900-3902
Dark gray lime	3902-3906
Brown shaly lime	3906-3912
Dark gray lime	3912-3926
Brown lime	3926-3940
Light brown ilme	3940-3953
Slate	3953-3958
Brown slaty lime	3958-4014

San Jon well, or McGee No. 2, is located 6 miles northeast of San Jon, sec. 14, T. 11 N., R. 34 E. The location is on the high, broad ridge forming the center of the uplift through Quay County. This well is in a slight depression on top of the dome,

which is 3 or 4 miles across. At a depth of 200 feet drilling was temporary suspended.

Endee well, about 10 miles northeast of the McGee No. 2, is in sec. 7, T. 11 N., R. 36 E. The location is on top of a broad dome forming a part of the general elevation east of Tucumcari. To the east, the southeast, and the south can be seen the escarpment of the Staked Plains, some 20 miles distant. The prevailing material of the well to a depth of 1,500 feet was blue shale. From 1,500 to 2,300 feet was mainly limestone. Red beds were not entered till about 2,500 feet. The project is being undertaken by the Endee Oil and Gas Co.

The Rana well is located near Rana. This well was spudded in and abandoned by the Reid-Penumex Oil and Gas Co.

The Standard Petroleum Corporation is drilling in sec. 25, T. 13 N., R. 31 E., 16½ miles northeast of Tucumcari, on the Canadian River. The log of this well shows a somewhat different arrangement of formations from those in the McGee well. The top of this well is in the formation that occurs about 400 feet down in the McGee well. The strata correspond quite regularly but average nearly half the thickness of those in the McGee well. The first 1,120 feet of the former correspond to those in the latter between 400 and 2,375 feet.

Log of Well, Sec. 25, T. 13 N., R. 31 E.

	Feet.
Red rock	0- 60
Red lime	60- 80
Sand rock	80- 120
Gray shale	120- 125
White sand	125- 170
Red shale	170- 177
Sand rock—water	177- 220
Gumbo	220- 255
Sand rock	255- 330
Gray shale—sand and salt water	330- 340
Sand	340- 522
Broken blue shale and sand	522- 560
Red shale	560- 615
Red lime	615- 635
Red shale	635- 855
Sand rock—salt water	855- 865
Red shale	865- 876
Sand rock	876- 885
Red rock	885- 890
Blue shale	890- 900
Red rock	900- 905
Gray lime	905- 983
Brown shale	983-1025
Mixed lime	1025-1075

Brown shale	1075-1090
Gray and brown lime—salt water	1090-1130
Water (in lime)	1130-1144
Blue shale	1144-1150
Dark brown shale	1150-1158
Gray shale and lime	1158-1168
Dark brown lime	1168-1200
Gray lime	1200-1210
Sand, water	1210-

Preparations for drilling were made on sec. 23, T. 8 N., R. 28 E., by the Moquay Co., but the project was abandoned.

A small dome 2½ miles east and half a mile south of Tucumcari appears to be a structural elevation, in sec. 20, T. 11 N., R. 31 E.

A large structure lies northeast of Tucumcari embracing parts of townships 11 and 12 N., ranges 31 and 32 E.

Southwest of Quay is a structure, central about on sec. 36, T. 8 N., R. 29 E.

Rio Arriba County

The county is largely overlain by Tertiary sediments. These have been eroded in certain places and the underlying Cretaceous sediments are exposed. There is considerable variety of topography. Over much of the area the sediments are relatively level or slightly modified by local flexures. Into these the streams have cut deeply, and frequently have laterally eroded the surface, leaving steep faces of buttes and mesas overlooking stretches of lower plain. The Chama River is the major stream. Its course much of the way through the county is a degradational one, through strata of sandstone and shales. In places the river has cut gorges 250 feet deep and scarcely more than that in width. Wider parts of the valley are bordered by gravelly terraces.

Some drilling has been done in this county. E. T. Williams started a well near Chama, which was later abandoned. A well was started on the J. R. Martinez ranch, 6 miles northwest of Park View. This was abandoned at 1,200 feet.

The Continental Oil Co. is drilling two wells on the Looney ranch, about 15 miles northwest of Tierra Amarilla.

A very favorable structure occurs on Willow Creek about 3 miles west of Park View. Willow Creek here cuts, in a narrow gorge, directly across the anticline, which extends nearly east and west. The structure is about 1½ miles across and its apex is about 80 feet above the creek. The south limb is much steeper

than the other, which brings the crest about 1 mile south of the north side of the structure. Where the creek emerges from the gorge, it crosses a fault line striking parallel to the main axis of the fold. The down-throw is to the north. The rock at the surface of the fold is very hard gray sandstone, weathering to a reddish brown color. Lying above this sandstone at the level of the valley is an exposure of oil shale.

Oil seeps are reported 2 miles northwest of Petaca; also 4 miles east of Chama.

Roosevelt County

The surface is of quite uniform topography, being closely allied to the Staked Plains type, of which it forms a part of the western margin. The general dip of strata is southeasterly. The surface formation is a thin Tertiary limestone, which is here and there overlain by a red loose sand. Underlying beds, dissolving, have caused slumping of the surface and the formation of sink-holes. These depressions often may be confused with structural "lows," as they both sometimes occur in the same neighborhood.

Portales is situated in an abandoned valley, known as the "Portales Valley," running southeasterly into Texas. South of the Portales Valley rises a broad, westward extension of the Llano Estacado. A ridge-like portion of this highland parallels the Portales Valley 6 or 7 miles south of Portales. On this ridge about 10 miles southeast of Portales is located the well of the Nu-Mex Oil Co., S. E. ¼ S. W. ¼ sec. 4, T. 3 S., R. 35 E. The well was down 900 feet, mostly in red beds. Drilling has since been temporarily suspended on account of litigation.

Roosevelt Oil Corporation, well No. 1, is located about 4 miles southeast of Garrison, on the S. E. ¼ sec. 7, T. 6 S., R. 37 E. The location is on the same general structure as the Nu-Mex well, which broadens toward the southeast.

Mesa well—Mesa Oil Co. of Portales—is located on N. W. ¼ sec. 27, T. 1 N., R. 30 E.

Tolar well, 3¾ miles north of Tolar, on N. W. ¼ sec. 8, T. 3 N., R. 29 E., was started by John Dahl. A rotary rig was set up, but operations were discontinued soon after starting.

Sandoval County

A considerable variey of topography is included in this county —sandy mesa, eroded plateau, lava-topped mesas, granite-cored mountains. Between Rio Grande and Jemez River igneous

rocks prevail. Much of the southwestern part west of Rio Puerco is covered with lava, while the Sandia Mountains rise to a height of 10,150 feet in the southeast corner. From the center of T. 14 N., R. 1 E., the surface slopes southeasterly to the Rio Grande, an undulating sandy mesa cut by the many arroyos, and sparsely covered with grass or scrubby red cedar. The eroded valley of Jemez River to the north presents a typical Bad Land topography.

Near the middle of the east side of sec. 12, T. 14 N., R. 1 W., sandstone beds dip east and southeast at angles of 70 degrees to 90 degrees forming a peculiar, sharply-rough topography. About 1½ miles southeast of this point, across a valley, strata outcrop still with a southeasterly dip but at an angle of 15 degrees. Across the low ridge and 1½ miles to the northwest the dip is 10 degrees southwesterly. The strata exposed on this anticline are probably Cretaceous.

The southwestern part of the county west of Rio Puerco is an eroded plateau. The westerly-dipping strata form one ridge after another, with intervening valleys sometimes grass-covered, sometimes thick with sage brush.

No wells are known to be located in Sandoval County.

San Juan County

San Juan County embraces the main part of the San Juan Basin. It is a structural basin, with the successive beds of sediments outcropping concentrically in strips of varying width. Much of the area lying north and east of Rio Chaco to the Colorado line is Tertiary; at least on the higher levels. West and south of this area occur outcrops of Laramie sandstone and Lewis shale in rather narrow belts. The broad expanse reaching across into McKinley County from Rio Chaco may, in general, be classed as Mesa Verde. The Choiskai Mountains in the southwestern part are also capped with Tertiary. Many minor variations of dip occur across the county. The surface of the interior is essentially barren and without water.

Mesa Verde Oil Co. well, No. 1, was spudded in May 16, 1918. It is located about 9 miles northeast of Farmington, in sec. 16, T. 30 N., R. 12 W. Drilling was suspended at a depth of 1,512 feet, but was resumed again in July, 1920. The location is in a valley leading into Las Animas Valley from the west. The log shows many intervening beds of sandstone, shale, and limestone.

Log of Mesa Verde Well No. 1, Sec. 16, T. 30 N., R. 12 W.

	Feet.
Yellow sand	0- 50
Blue shale	50- 100
White sand	100- 120
Blue shale	120- 140
White lime shell	140- 150
Blue shale	150- 160
White sand—showing of oil	160- 265
White lime shell	265- 267
White sand	267- 285
Blue shale	285- 315
White sand—lime and strong flow sulphur gas	315- 350
White sand	350- 380
White sand—of quartzite nature containing iron pyrites	380- 465
Blue shale	465- 475
Black lime	475- 490
White sand	490- 500
Gray lime	500- 530
Pink lime	530- 540
White lime shell	540- 580
Red mud	580- 590
White lime shells	590- 630
White lime	630- 645
Light shale	645- 650
White lime shell	650- 670
Light shale	670- 685
Blue lime	685- 700
Light shale	700- 710
White sand	710- 745
White lime	745- 755
Blue shale	755- 780
White sand	780- 790
Blue lime, very hard	790- 795
White sand, coarse, good showing high grade oil	795- 810
White lime	810- 820
Brown shale	820- 830
Blue lime	830- 840
White sand, coarse	840- 855
Brown shale, sandy	855- 865
Blue lime	865- 875
White sand, coarse	875- 877
White sand, coarse, strong flow gas; oil, with salt water	877- 897
Blue shale	897- 917
Lime shell and shale	917- 930
Lime shell, blue	930- 935
White sand, coarse	935- 955
Shale, blue, and white lime mixed	955- 985
Blue shale	985-1005
White lime shells—strong showing petroleum gas	1005-1010
Gray sand, coarse	1010-1050

White sand, fine, strong flow salt water	1050-1055
White lime	1055-1057
Blue lime	1057-1072
White sand, coarse	1072-1075
Blue lime	1075-1100
White sand, coarse	1100-1120
Shale and lime shells	1120-1135
Blue lime	1135-1140
White sand	1140-1150
Gray sand (nice showing, green oil)	1150-1160
Blue lime	1160-1175
Blue shale	1175-1240
Blue lime and shale	1240-1262
Lime shells	1262-1280
White sand, coarse	1280-1301
Mud, light blue	1301-1317
Lime shells	1317-1325
Blue shale	1325-1326
Gray sand	1326-1331
Shale and lime, broken, with some sand	1331-1415
White sand	1415-1421
Mud, light pinkish	1421-1433
Blue shale	1433-1453
Lime shells	1453-1462
Blue shale	1462-1491
Lime, shale and sand—broken	1491-1509
Black lime	1509-1512

Mesa Verde well, No. 2, is about 2 miles west of well No. 1, on sec. 18 of the same Township. It is some 200 feet higher than well No. 1. A showing of oil and gas was made at 175 feet. At 610 feet a showing of inflamable gas. From 807 to 845 feet, several gallons of oil were baled out, and oil showings continue to 890 feet. This well was later abandoned.

Log of Mesa Verde Well No. 2,
Sec. 18, T. 30 N., R. 12 W.

	Feet.
Brown sandstone	0- 60
Blue shale	60-105
White sand	105-160
Blue shale	160-175
Lime shells	175-180
White sand coarse	180-205
Blue shale	205-227
White sand, coarse	227-242
Blue shale, muddy	242-247
White sand, coarse	247-282
Lime shells, gray	282-285
Brown shale	285-290
White sand, coarse	290-350
Brown shale	350-360
White sand, fine (shells and fresh water)	369-390

White sand, coarse	390-430
Blue shale, muddy	430-440
White sand, coarse	440-499
Lime shells, gray-brown	499-504
White sand, coarse	504-529
Gray lime shells, hard	529-533
Sand, quartz-like—boulders, etc	533-550
White lime	550-558
Lime shells, sand, conglomerate	558-600
White lime	600-608
Gray sand	608-610
Blue shale	610-614
Blue mud	614-619
Lime shells in shale	619-624
Lime shells	624-642
Brown shale	642-650
Sand	650-660
Lime shells	660-690
Brown shale	690-695
Lime shells	695-710
White sand	710-722
Lime shells	722-730
Blue shale	730-740
Lime shells, white, and then blue	740-770
Sand	770-775
Lime, blue shale, light mud	775-807
Gray sand, fine	807-845
Lime, shale, sand, mixed—color blue	845-890

Interest in the possibilities of this region has been lately revived and new drillings are in prospect.

In the summer of 1920 the E. T. Williams Syndicate began drilling in sec. 2, T. 30 N., R. 12 W. The Farmington Times-Hustler of Dec. 9, 1920, contains the following information on this drilling: A heavy, dark-colored gas was encountered in the Pictured Cliff sands, 2,100 to 2,250 feet. Several strata of coal were found between 1,700 and 2,085 feet, one of them being 14 feet thick. Seven distinct gas sands have been encountered. On Dec. 12 this well was reported to be at a depth of 2,900 feet, in the Lewis shale.

The Farmington well, near the town of Farmington, T. 29 N., R. 13 W., was drilled in 1906-7. Dr. F. A. Jones collected data on this well in June, 1908, as follows: Depth of well was 2,730 feet. A heavy flow of gas was struck at 730 feet. At 2,720 feet a 5-foot vein of coal was encountered. Mr. John A. Weher gives data: "In the Farmington well the Pictured Cliff formation was penetrated at 1,200 feet. The Lewis shale is 1,000 feet thick, with hot salt water at its base. No strong oil indications have been observed in this formation in any of the wells drilled

in this part of the San Juan Basin. The Mesaverde is about 1,400 feet thick where it out-crops in the Great Hogback 20 miles northwest of Farmington, and the Farmington well had probably reached the middle of that formation at 2,700 feet, when the tools were lost and the hole abandoned. At this depth artesian water and some crude oil were encountered. Several gas zones were passed through; also oil showings at different horizons."

San Miguel County

From Las Vegas west, the surface is quite mountainous or rough. Triassic sediments dip steeply eastward, and at Las Vegas are overlain by Cretaceous shales and limestones. Triassic sediments again appear in the southeast part of the county.

The only well yet located in this county is on the Romero dome. The site is 20 miles north of Cuervo, the S. E. corner of sec. 28, T. 13 N., R. 24 E. Preparations for drilling were being made in July, 1920, by the Romero Dome Oil Syndicate. This site is 6 or 7 miles northeast of the center of the structure. The structure is very definite and extends over an area some 10 miles in diameter. Its center is near the S. W. corner sec. 24, T. 12 N., R. 23 E.

Santa Fe County

The northeastern quarter of the county is very rugged. Granitic uplifts cover practically this entire portion. The southeastern quarter is rough with deeply eroded sediments. The western half is naturally divided into two parts by the Galisteo River. To the north of this, broad mesas stretch from Santa Fe to the Rio Grande. Extensive lava flows cover the border next to Rio Grande.

To the south of Galisteo River the surface is essentially a plain, reaching southward to form the northern portion of Estancia Valley. A cluster of granitic mountains lie along the west border.

No wells had been drilled in Santa Fe County up to August, 1920.

Sierra Conty

The Fra Cristobal and Los Caballos ranges are block mountains, their steep escarpmests overlooking the Rio Grande valley, their eastern slopes forming the western limb of the Jornado del Muerto syncline. On their crests, Pennsylvanian strata are exposed, lying against granite. At the bases of these

mountains, on the east, the sands of the semi-desert plain stretch relatively level beyond the limits of the county.

The general surface of the county west to the Black and Mimbres ranges is deeply dissected by many arroyos leading toward the Rio Grande. In this respect it differs from the plains on the other side of the Rio Grande, where erosion has scarcely become effective.

No wells were reported from Sierra County.

Socorro County

The surface is, in general, rough or mountainous. Between mountain ranges stretch broad valleys with very little change in topography for 10 to 20 miles. Other areas are rough with the remnants of deeply eroded highlands. The county is so large that no general description can indicate the variety of surface.

Up to the present time only two wells are being drilled in the county. Several areas have been located where the structure is favorable.

Messrs. Kelley and Estelle, of Magdalena, are drilling in sec. 17, T. 3 N., R. 14 W., about 18 miles northeast of Quemado. The well is located in a valley, with an 800-foot escarpment of southwestward-dipping strata to the west. About 1½ miles north rises an igneous plug—Mt. Vetechadow—having a slight outflow of lava. Several dikes cut the strata from the central mass, one of these forming the northeastern side of the valley in which the well is located.

A portable rig was in operation when this well was visited, July 31, 1920. Artesian water was encountered at about 200 feet.

About 10 miles east of Datil, sec. 8, T. 2 S., R. 8 W., a well is being drilled by the Von Hagen Oil Corporation. The well is located on a north-south structure rising in a broad plain—"San Augustine Plains"—extending 15 miles east and west and some 25 miles north and south. This valley is surrounded by mountains, from whose slopes the downward-dipping strata stretch across the valley. The floor of this valley is modulated by numerous structural undulations similar to the one on which the Von Hagen well, No. 1, is located.

About 18 miles east of Socorro there is reported a well-defined structure. Sec. 4, T. 3 S., R. 4 E., is located upon this structure. This area is not readily accessible, being some 50 miles from Socorro by road.

The structure of an area northwest of Puertecito has been mapped and described by E. H. Wells. Dean E. Winchester has treated the geology of a larger area in the same section of the county.

Taos County

This county was not visited by the writer. He is informed that no drilling for oil is being done. Some interest is being maintained, by citizens of the county, in oil locations around Ojo Caliente.

Torrance County

The Manzano Mountains, bordering the western edge of the county, dip toward the east, forming a rugged escarpment on the west. Sediments of upper Pennsylvanian age outcrop along the rim and form the eastern slope for several miles from the summit of the range. These sediments are overlain by the thick beds of Tertiary and Quaternary deposits of the Estancia Valley. South of the Santa Fe R. R., the Chupadera Mesa forms the main topographic feature. This mesa lies to the west of a wide valley, 10 miles wide, leading southeastward from T. 3 N., R. 8 E. Its northern end, upturned, forms a steep escarpment overlooking a part of the Estancia Valley. There is no well-defined surface drainage through the valley. The surface is covered by a sandy loam from one to many feet thick, and supports a sparse growth of grass.

The Estancia Valley embraces the central portion of the county as well as the southern part of Santa Fe county. Its maximum extent north and south is 65 miles; east and west, is 40 miles. The valley is a structural basin partly filled with sediments washed in from the surrounding highlands. It has no outlet and in its lowest parts are several salt lakes. The position and depth of these lakes are maintained by the erosive action of the wind when the lake beds are dry. The wind-blown silt is heaped in dunes on the eastern margins of these depressions.

The Hills of Pedernal is a structural elevation lying to the east of Estancia Valley. The northern end of this uplift is composed of rugged metamorphic rocks, the southern end being a broad, rolling surface. The surface from Lucy eastward for about 5 miles rises over this uplift, which extends across several townships north and south. The surface east of the Pedernal Hills as far as Encino is structurally undulating. Outcrops of crystalline rocks occur southeast of Pedernal Mountain as far

as sec. 7, T. 5 N., R. 13 E. This rock is also struck in some wells in that vicinity.

Encino Basin is a structure depression enclosing a flat area of ancient lake deposits about 6 miles north and south and 3 miles east and west. This area lies mainly in the S. E. part of T. 5 N., R. 14 E. Pinos Wells Basin lies south of Encino Basin and is about equal in area, with deposits of sediments and salt similar to those of Estancia and Encino basins. The upland to the east of these salt basins slopes toward the Pecos River.

Pennsylvanian strata outcrop along the eastern slopes of the Manzano range and cover much of the southwestern part of the county south of the A., T. & S. F. R. R. From Estancia Valley east, the uplands show a surface rock of caliche, which is referred to the Tertiary. This deposit, which is relatively thin, overlies gypsiferous beds of Permian or Triassic age.

Some oil well locations have been made in Torrance County. A water well of the A., T. & S. F. at Willard reached a red sandstone at 312 feet. At Lucy a well penetrated alternating layers of red clay and limestone and entered black shale at 350.

Gas in wells is reported in several instances along a line passing southeasterly from Manzano to the south line of the county in the foothills of Gallinas Mountains. Mr. Whitelow, who has drilled many water wells in this part of the country, says "the gas-bearing sand belt is about a mile wide" along this line. In a well drilled by him, called the "Gallina," or "Simpson," well, located on or near sec. 17, T. 1 N., R. 10 E., a strong showing of gas was struck at a depth of 800 to 860 feet. Favorable structures appear in this locality.

Wells are reported to be drilling at Duran and near Manzano.

Union County

The surface is, in general, a high plain through which numerous streams have cut their valleys toward the east and southeast. Remnants of the former relatively level surface form broad areas of fertile land between the main drainage valleys. Large areas, mainly in the northern part, are covered with lava beds, flat and barren.

In general, the uppermost formation in the county is a thin Tertiary limestone or caliche. This formation is underlain, in the northwestern part of the county, by Cretaceous sediments. Probably over the major portion of the county Triassic beds immediately underlie the Tertiary. These beds outcrop along

the deeper valleys to a depth of 300 or 400 feet, and, in the southern part of the county, form the main surface rocks.

A number of structures have been determined. Several of these form a general north and south uplift from the southern part of the county along the vicinity of Ute Creek to T. 25 N., R. 28 E. Mr. C. W. Buskirk has located four of these as follows: the Pasamonte structure, in parts of townships 22, 23, and 24 N., ranges 30 and 31 E.; the Baca structure, covering parts of townships 19, 20, and 21 N., ranges 30 and 31 E.; the Gallegos structure, in townships 16, 17, and 18 N., ranges 30 and 31 E.; the Bryantine structure, in townships 14 and 15 N., ranges 30, 31, 32, and 33 E. A fifth structure prominent in the eastern part of Colfax County reaches across the line into T. 25 N., R. 28 E. This is known as the Palo Alto structure. Another structure is reported in the valley of the Cimarron River, sec. 6, T. 31 N., R. 33 E.

At least two of these structures have been tested by deep drillings. The United Oil Co. has completed a well in the N. W. ¼ N. W. ¼ sec. 6, T. 31 N., R. 33 E. This is called the Baker well, No. 2. It is located on the east flank of the dome, the upper formation being the Fountain series of the Triassic. Drilling began Feb. 5, 1919, and was abandoned Dec. 31, 1919, granite having been struck.

Log of Baker Well No. 2

N. W. ¼, N. W. ¼ Sec. 6, T. 31 N., R. 33 E.

	Feet.
Blue sand	0- 20
Blue sandy shale	60- 68
Sand—little water	68- 108
Blue shale, brown shale	108- 159
Red sand shale	159- 179
Hard coarse sand	179- 193
Red broken sand	193- 210
Hard red sand	210- 227
Red shale	227- 244
Red shale—hard lime	244- 259
Broken lime and sand	259- 271
Sandy red shale	271- 293
Broken lime and sand	293- 309
Red sandy lime	309- 319
Red sand—shale	319- 334
Red sand, shale, lime	334- 350
Red sandy lime	350- 365
Hard lime	365- 373
Broken lime and red shale	373- 400

Red sandy shale	400- 416
Red shale, hard lime	416- 476
Red shale	476- 501
Hard sandy lime	501- 589
Broken shale and lime	589- 615
Blue shale	615- 652
Sand, shale, and lime	652- 680
Sharp sand	680- 695
Sand, blue shale	695- 720
Hard sand	720- 737
Hard sharp sand	737- 760
Sandy blue shale	760- 778
Broken lime and hard sand	778- 788
Soft and hard sand	788- 860
Water sand	860- 880
Red sand	880- 898
Red sand, hard lime	898- 903
Red sand, water sand	903- 920
Broken sand, water	920- 935
Red hard sand	935- 945
Red sandy shale	945- 960
Red hard sand	960- 970
Red sandy shale	970- 982
Hard sands, lime	982- 995
Red sand	995-1015
Red sandy shale	1015-1030
Red hard lime, broken	1030-1091
Soft sand—some water	1091-1157
Red water sand	1157-1172
Red sharp sand	1172-1205
Hard lime and sand	1205-1211
Red hard lime and sand	1211-1240
Red sand and lime shale	1240-1260
Red broken sandy shale	1260-1277
Red hard sand and lime	1277-1324
Red broken sand and lime	1324-1342
Red hard sand	1342-1357
Red sandy shale	1357-1372
Hard lime	1372-1376
Hard lime and sand	1376-1408
Red sandy shale	1408-1441
Hard red rock	1441-1545
Red coarse sand	1545-1700
Red rock	1700-1927
Brown cave	1927-1948
Red cave	1948-1953
Red rock	1953-1960
Red hard sandy lime	1960-1973
Hard white sandy lime	1973-2080
Red coarse lime	2080-2104
Red sand—water	2104-2123
Red hard sand	2123-2146
Red sand	2146-2597
Dark sandy lime	2597-2647
Gray sandy lime	2639-2647

Dark gray sand	2647-2654
Pink sand	2654-2656
Pink sandy lime	2656-2660
Sand, pink-gray	2660-2663
Pink sand	2663-2670
Red sand	2670-2680
Red sand	2680-2725

A well known as Baca well, No. 1, was drilled on the Baca structure by the American Producer's Corporation. This structure lies along Ute Creek valley, and the well is located on the west bank of Ute Creek, S. W. ¼ N. W. ¼ sec. 32, T. 20 N., R. 31 E. A succession of red beds, similar to that found in the Baker well, was penetrated to a depth of about 2,200 feet. A very strong flow of non-combustible gas was struck in this well.

The Buffalo Oil Syndicate is drilling on the Odiorne farm in the S. E. corner sec. 3, T. 24 N., R. 36 E. No log was obtainable. This well is located on a prominent portion of the Llano Estacado, about 12 miles southeast of Clayton.

Valencia County

The county lies in the Plateau region. Its surface includes a variety of rough topography. The Zuni uplift covers the northwest corner. This immense dome is formed of a granite mass with surrounding uplifted beds of Carboniferous sediments through which it has pushed its way. Mt. Taylor, with its environs of lava-flows, is scarcely separate from the great igneous outflow that extends southwest across the center of the county, embracing more than a dozen townships. Many lava-topped mesas occupy a large part of the eastern end of the county. Succeeding this to the west is a narrow strip of Carboniferous, followed by a belt of Triassic beds 20 miles wide. A corresponding belt of Triassic covers the western end of the county as well as surrounding the Zuni uplift, forming the outer rim of the general area of the San Juan Basin. Cretaceous sediments cover most of the central portion that is not overlain by lava beds.

The general structure of the county is a U-shaped synclinal basin, the Zuni uplift destroying its uninterrupted connection with the main San Juan Basin.

The Red Lake anticline, a structure appearing in the Puertecito district, is described by Prof. E. H. Wells in his report on the region. The structure occurs in secs. 3, 4, 9, and 10, T. 4 N., R. 7 W.

No oil wells have been drilled in Valencia County, as far as is known.

SUMMARY

We have considered the oil situation in each county of the state. Reports have been received of some 50 wells, located in at least 19 counties. Other wells have been drilled, or are drilling, from which no data have been received. Drilling is especially active in the eastern third of the state, in the San Juan Basin, and the Tularosa Basin. No wells can be said to be really producing oil at the present time, although a few have produced a few barrels daily for a limited time. However, the efforts now being put forth by oil companies are, in many instances, thorough, and are calculated to demonstrate definitely the presence or absence of oil in the most favorable localities. The combined results of these efforts can not fail eventually to give a decisive answer concerning the possible productivity of the state.

The Pennsylvanian formation probably underlies the greater portion of the state. It is observable at the surface where uplifts have exposed the edges of underlying sediments, but over a large part of the area it is buried deeply beneath later deposits. In the eastern half of the state deposits of the Red Beds are 1,000 to 3,000 feet thick. Owing to the absence of organic remains in these rocks, oil would not be expected in them. The showings of oil in this region seem to come from the upper part of the underlying Pennsylvanian deposits. The thickness of Pennsylvanian deposits under the Red Beds has scarcely been demonstrated, although several deep drillings in the northern part of the region have penetrated to granite at a depth of 4,000 feet or less. It is not surprising that traces of oil should occur at certain horizons in Pennsylvanian rocks in this region.

The many apparently favorable structures occurring in the northeast part of the state probably may not be depended on for the accumulation of oil. Numerous tests will be necessary to demonstrate the uniform origin of these uplifts, whether or not they are due to granitic intrusions, and if they are oil-bearing.

In the San Juan Basin the traces of oil occur at rather shallow depths in Cretaceous formations. The outlook here is more favorable than in the eastern part of the state and it is not

unlikely that further tests may lead to the discovery of areas of moderate productivity.

The Tularosa Basin and similar areas in the southwestern part of the state have not been exploited to any great extent. The prevailing desert conditions and the difficulty of determining structure due to the level, sand-covered condition of surface have delayed development. It is not unlikely that some small deposits of oil may be discovered in this portion of the state. The prospects seem at least as favorable as for the Pecos Valley to the east.

The highly-colored propaganda of certain corporations would lead the public to believe New Mexico is to become a rival of the mid-Continent field. Their literature is intended to induce the overtrustful mortal to make a ready investment in oil stock. Every effort is made to bring about a wild and headlong excitement over the marvelous wealth about to be discovered in a certain area, where conditions are "just like those in the Ranger field," etc. Little regard is paid to setting forth the facts as far as they are known.

It is not likely that New Mexico will be a large producer of oil. The conditions of stratigraphy and the present showing of drill-holes do not indicate the presence of great deposits. However, encouragement should be given to efforts being put forth to demonstrate successfully the actual conditions.

New Mexico is undoubtedly a state of immense mineral wealth. It is already apparent that the present progress in mining is only the beginning of the development of the state's resources. While so much attention is being given to the matter of oil production in the state, more attention should be given to the conservation and the exploitation of those resources which are plainly accessible and whose utility is greater than all of the production of petroleum probable for the state.

The irrigation question is an important one in New Mexico. The possibilities resting in artesian water for this purpose are becoming evident. What is being done in the Pecos Valley may be paralleled in others of the southern counties. A well recently drilled for oil in eastern Luna County encountered five strong flows of water above 700 feet depth.

APPENDIX

FOURTH LEGISLATURE **STATE OF NEW MEXICO**

HOUSE BILL No. 186

(As amended)

AN ACT

Providing for the Leasing of State Lands for Mineral Purposes, and Providing for the Issuance of Limited Patents for Mineral Lands and for Other Purposes.

Be it Enacted by the Legislature of the State of New Mexico:

Section 1. The Commissioner of Public Lands is hereby authorized to issue leases for the exploration, development and production of coal, oil and gas, and other minerals on sny State lands upon such terms and conditions as he may deem to be for the best interests of the State and prescribed by the terms of this Act. Such leases shall run for a maximum term of ten (10) years, or as long thereafter as mineral in paying quantities shall be produced from the leased lands. The minimum rental for oil and gas leases shall be One Hundred Dollars ($100.00) per annum, and the minimum rental for leases for other minerals shall be Twenty-Five Dollars ($25.00) per annum. On all oil and gas leases the State shall receive a royalty of not less than one-eighth (⅛) of the oil and gas produced and saved from the leased lands, or the cash value thereof, payable monthly. The leassee of said lands for coal mining purposes shall be required to pay such rental as the Commissioner may demand, and in addition thereto a royalty of not less than ten cents (10c) per ton on all coal produced, payable monthly. In all other forms of mineral leases, the State shall receive not less than five (5) per cent of the net proceeds derived from the sale of minerals produced on the land after transportation and treatment charges are deducted.

Section 2. The Commissioner of Public Lands shall prescribe the minimum rental to be paid by all lessees of State mineral lands and the minimum rental agreed upon shall be paid whether the lands are operated for minerals or not. Lessees shall be required to submit annual reports showing in detail their operations for the preceding year, and such reports shall be verified by the oath of the lessee or his authorized agent. False and fraudulent statements wilfully made in any such report shall subject the person making the same to the penalties prescribed by law for the crime of perjury.

Section 3. State lands sold heretofore, or which may be sold hereafter on any deferred payments plan under contract containing a reservation to the State of the minerals therein contained, the full amount of the purchase price not having been paid, or patent not having been issed, may be leased by the State as in this Act provided in the same manner as other State lands;

PROVIDED, that before any lease shall be issued for lands which have been sold, the applicant shall file with the Commissioner of Public Lands a good and sufficient bond or undertaking, to be approved by the Commissioner, in favor of the State of New Mexico, for the use and benefit of the purchaser of such lands, his grantees or successors in interest, to secure the payment to such purchaser or his successors for such damage to the livestock, range, water, crops or tangible improvements of the purchaser or his successors in interest as may be determined and fixed in any action brought upon the bond or undertaking in a court of competent jurisdiction against the principal and sureties thereon resulting from the use of and operations on the land by such mineral lessee of his successors in interest

PROVIDED FURTHER, that if any such purchaser shall file with the Commissioner a waiver, duly executed by him, of his right to require such bond, the Commissioner may issue a mineral lease without requiring the lessee to furnish the bond herein provided.

Section 4. Where State lands have been sold heretofore, or may be sold hereafter on any deferred paymnet plan under contract containing a reservation to the State of the minerals therein contained and before the payment of the total purchase price, such lands shall have been leased for mineral purposes as in this Act provided; or where before the payment of the full amount of the purchase price shall have been made or patent issued, the land shall be known, classified or reported as mineral lands, or where by reason of proximity to known mineral lands

or productive oil or gas wells, the Commissioner of Public Lands shall deem such lands to be of probable mineral character and valuable as such, he shall make proper notation on the records of his office, designating the said lands as mineral lands The Commissioner of Public Lands is hereby authorized to issue to the purchaser of any such mineral lands or lands so classified as mineral, upon full payment of the purchase price according to the terms of the contract, a limited patent only, which shall contain reservation to the state of New Mexico of all the minerals in the said lands, together with the right to the State or its grantees, to prospect for, mine and remove the same; and such lands shall, notwithstanding the issuance of such patent, be subject to lease under the provisions of this Act;

Provided, that no lease for such lands shall be issued and no person shall be authorized to prospect for, mine or remove any minerals until an indemnity bond shall be given or waiver of the same filed, as set forth in Section 3 of this Act.

Section 5. All laws or parts of laws in conflict herewith are hereby repealed, and this Act shall be in force from and after its passage and approval.

Section 6. That it is necessary for the preservation of the peace, health and safety of the inhabitants of the State of New Mexico that the provisions of this Act shall become effective at the earliest possible date, and hereby an emergency is declared to exist and this Act shall be enforced and in effect from and after its passage and approval.

Approved March 17, 1919.

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